Finite Element Model of SCOLE Laboratory Configuration

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MODEL DESCRIPTION

DEFINE ELEMENT PROPERTIES :

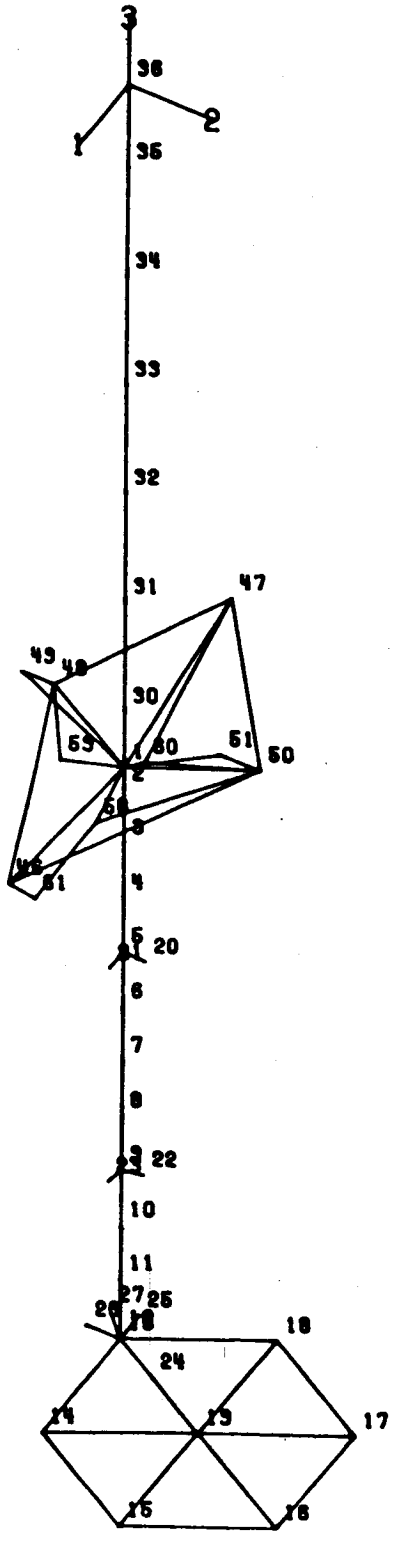
- MATERIAL CONSTANTS
  MODULUS OF ELASTICITY,
  POISSON'S RATIO,
  DENSITY

- MAST, REFLECTOR, RIGID LINKS AS BEAM ELEMENTS
- CABLE AS BAR ELEMENT (AXIAL STIFFNESS ONLY)
- SHUTTLE AS VERY STIFF BEAM (ASSUME RIGID)

JOINT LOCATIONS AND CONNECTIONS :

- 44 JOINTS TOTAL, 7 FOR CABLE, 12 FOR MAST, 6 FOR REFLECTOR AND REST FOR RIGID MASSES

JOINT LOCATIONS



SCOLE

0 3
SCALE

MODEL DESCRIPTION (Continued)

TWO BOUNDARY CONDITIONS MODELLED:

CASE 1–SUSPENDED (6 DOF FOR ALL JOINTS EXCEPT TOP OF CABLE)

CASE 2– CANTILEVERED CABLE, SHUTTLE PLATFORM FIXED IN ALL DOF

INCLUDE RIGID MASSES AND CONNECTIONS :

- ACTUATORS
- SENSORS
- SHUTTLE PLATFORM AND COMPONENTS

CALCULATIONS :

- STIFFNESS AND MASS MATRICES
- INITIAL STRESSES (DUE TO GRAVITY LOADING)
- STATIC DISPLACEMENTS AND REACTIONS
- EIGENSOLUTIONS – FREQUENCIES AND MODE SHAPES

FREQUENCY DATA FOR CANTILEVERED CASE (FIG 1,2)

MODE	FREQ (HZ) EAL	LAB	DELTA-%	EAL/LAB RATIO
1	0.443	0.44	0.7	1.01
2	0.447	0.44	1.6	1.02
3	1.504	1.54	2.3	0.98
4	2.913	3.00	3.0	0.97
5	4.345	4.36	0.3	0.99
6	6.821	3.08	121.5	2.21

FREQUENCY DATA FOR SUSPENDED CASE (FIG 3,4)

MODE	FREQ (HZ) EAL	LAB	DELTA-%	EAL/LAB RATIO
6	0.566	0.55	2.9	1.03
7	0.638	0.65	1.8	0.98
8	1.514	1.62	6.5	0.93
9	2.940	3.10	5.0	0.95

RATIO OF SUSPENDED TO CANTILEVERED FREQUENCIES (FIG 5,6)

MODE*	EAL	LAB
1	1.28	1.25
2	1.43	1.48
3	1.01	1.05
4	1.01	1.03

* NOTE: SUSPENDED MODES 6-9 CORRESPOND TO CANTILEVERED MODES 1-4

FIG. 1 EAL & LAB FREQUENCIES
CANTILEVERED CASE

O - EAL DATA

◇ - LAB DATA

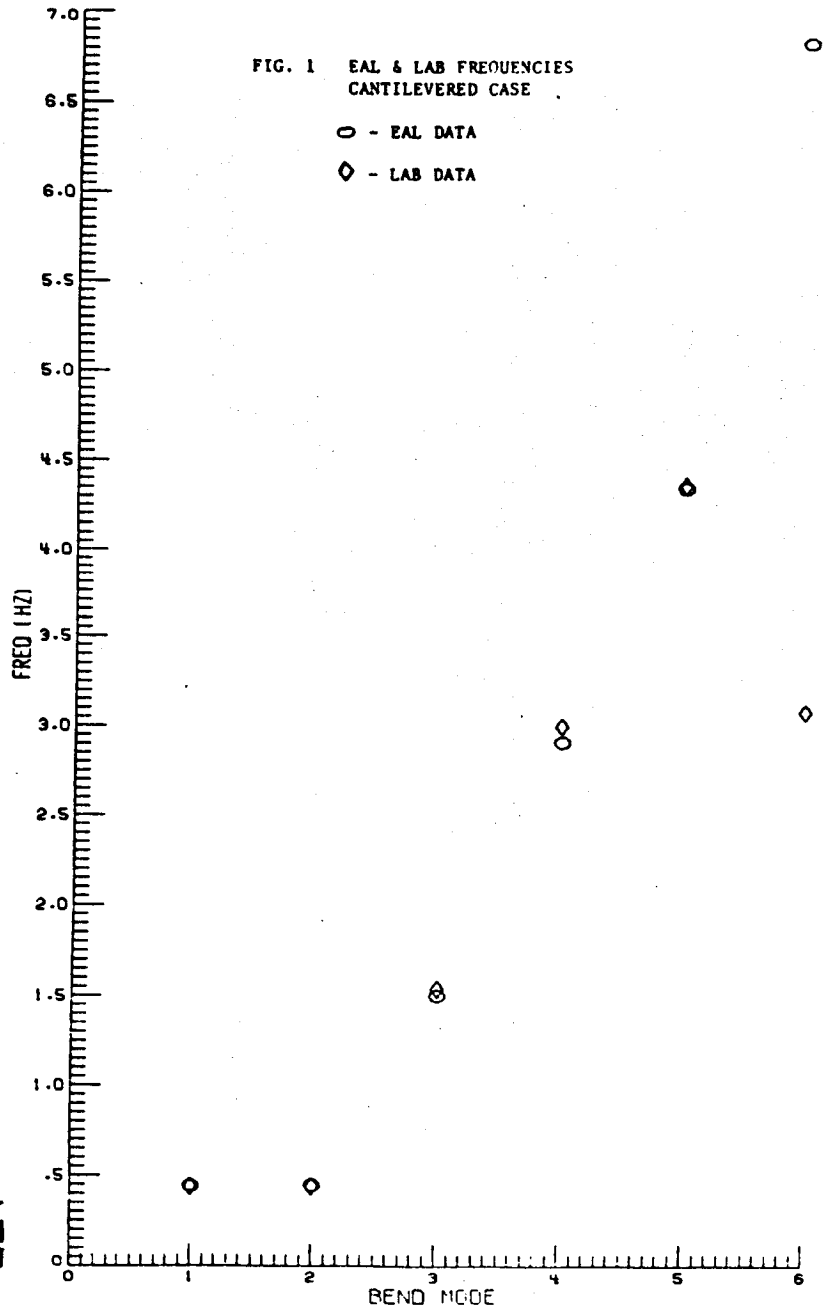


FIG. 2 RATIO OF EAL TO LAB FREQUENCIES
CANTILEVERED CASE

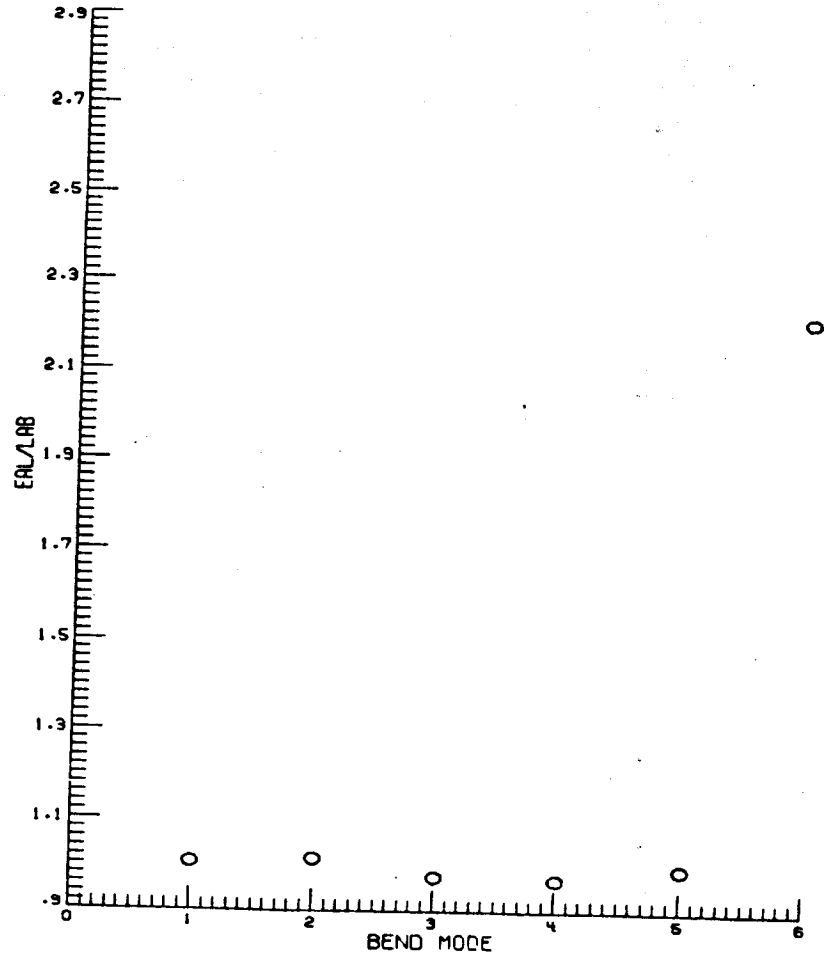


FIG. 3 EAL & LAB FREQUENCIES

SUSPENDED CASE

O - EAL DATA

◇ - LAB DATA

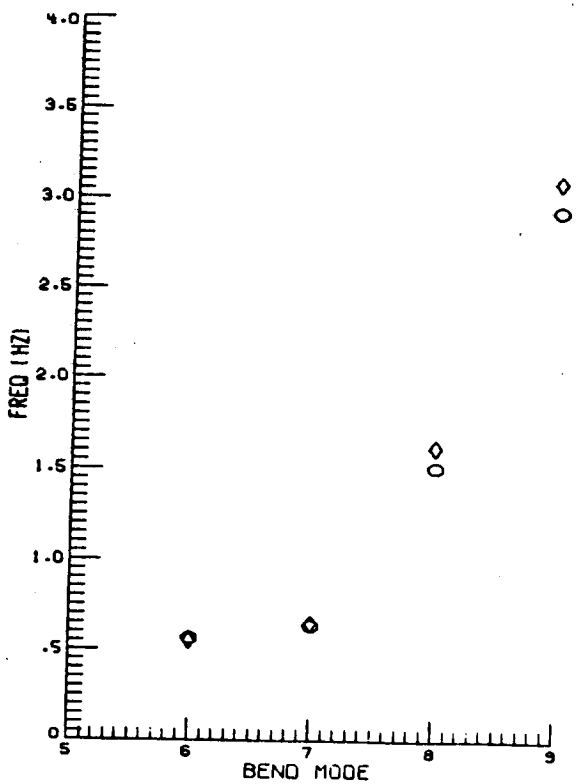
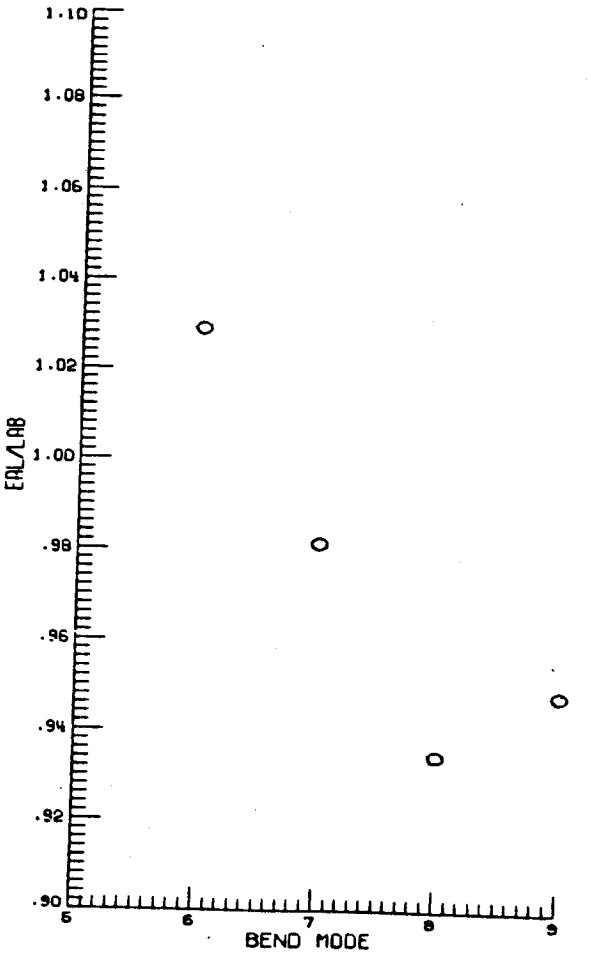


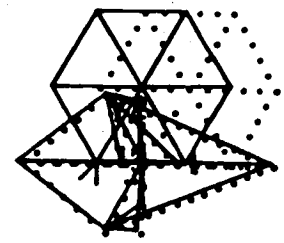
FIG. 4 RATIO OF EAL TO LAB FREQUENCIES
SUSPENDED CASE

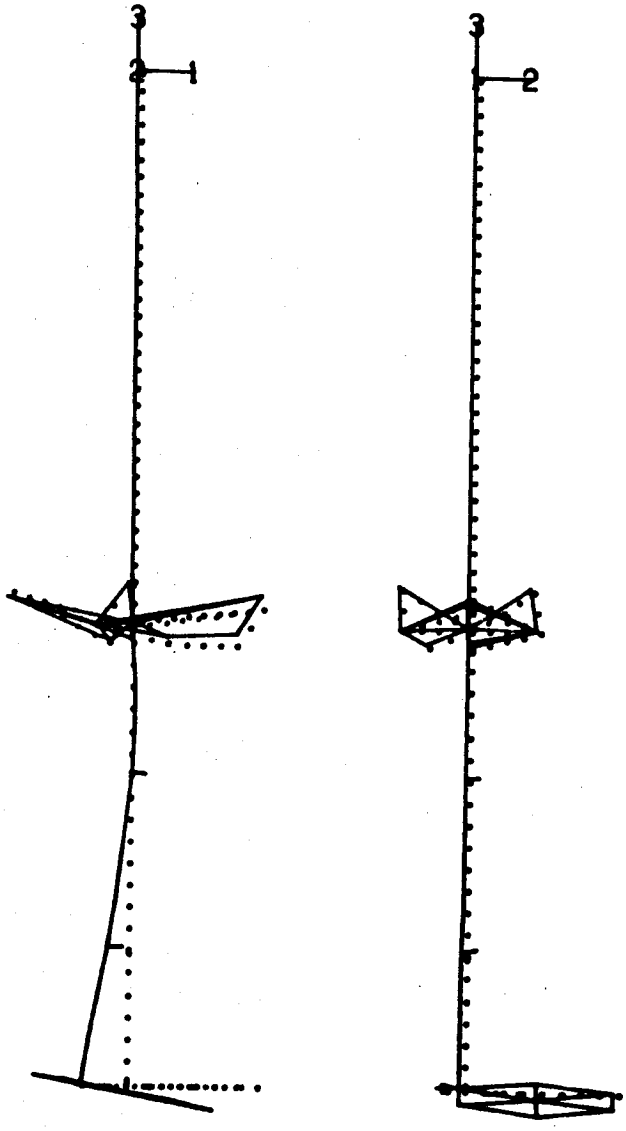


EAL PLOT 1st PITCH
SUSPENDED CASE

MODE. FREQ (HZ) . 5657 X10 +0 0

ID= 1 / 1 / 6





SCOLE VIBRATIONAL MODE SHAPE 6

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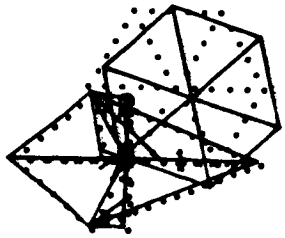
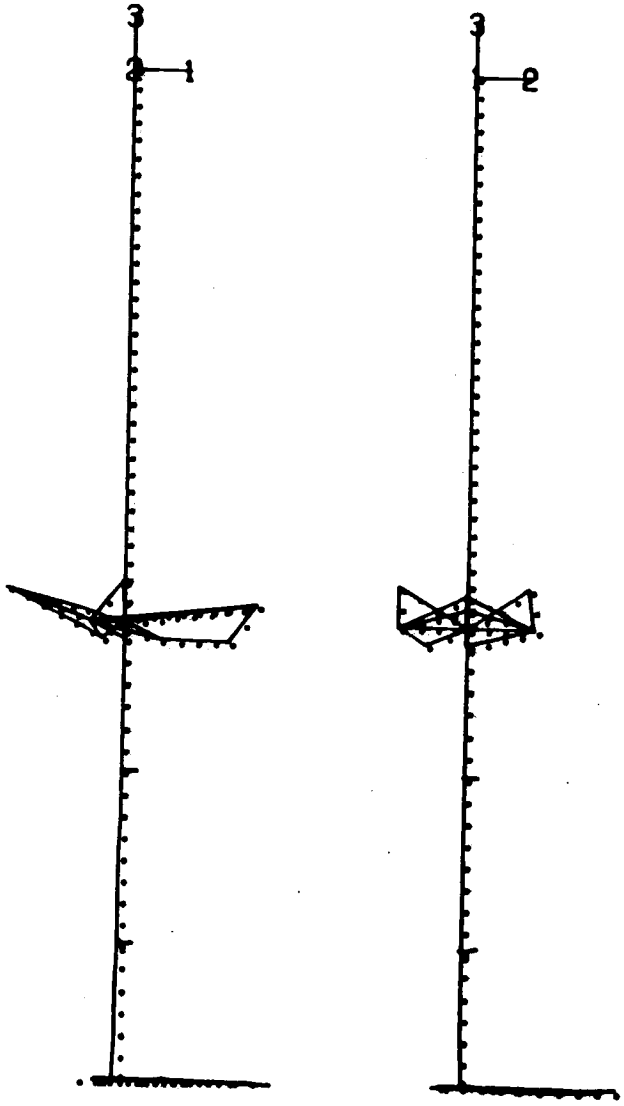
0 SCALE

EAL PLOT 1st TORSIONAL
SUSPENDED CASE

MODE. FREQ (HZ) . 1513 X10 +01 ID= 1/1/8





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SCOLE VIBRATIONAL MODE SHAPE 8

0 SCALE

FIG. 5 RATIO OF LAB FREQUENCIES
SUSPENDED/CANTILEVERED

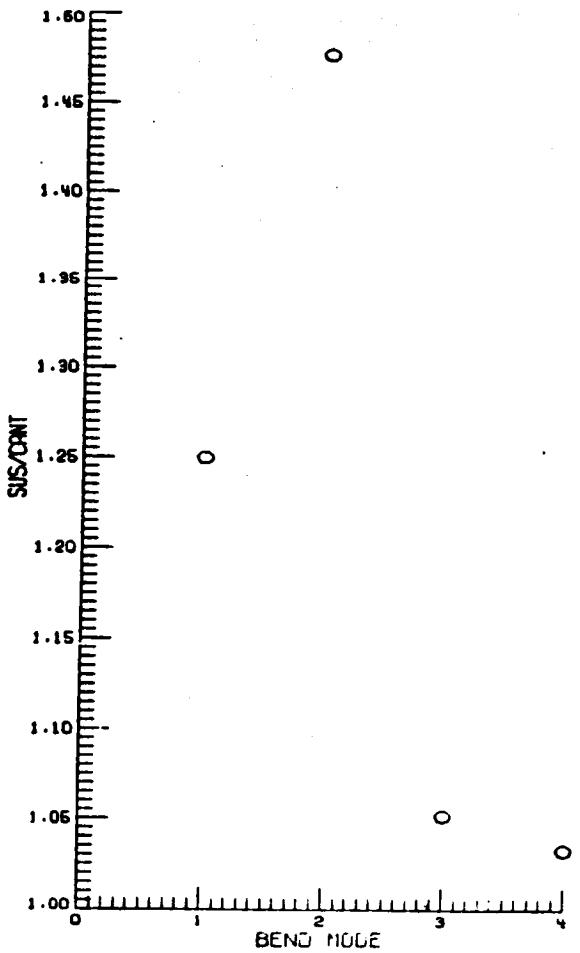
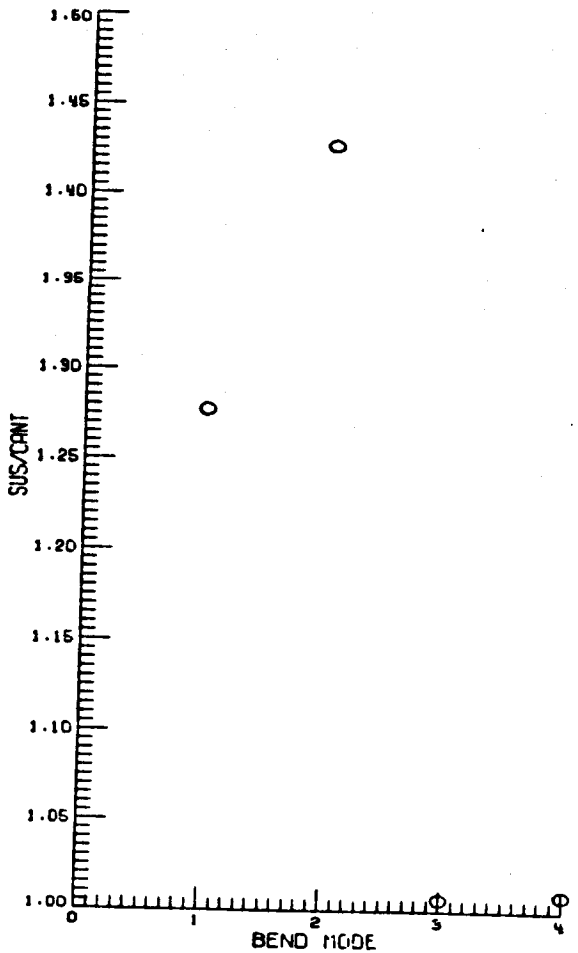


FIG. 6 RATIO OF EAL FREQUENCIES
SUSPENDED/CANTILEVERED



COMMENTS

- EAL, LAB DATA IN GOOD AGREEMENT
- HIGHER MODES TEND TO HAVE SLIGHTLY LARGER DIFFERENCES BETWEEN EAL & LAB RESULTS
- FOR HIGHER MODES, FREQUENCIES OF THE SUSPENDED AND CANTILEVERED CASES ARE SIMILIAR; THE MODE SHAPES ARE ALSO CLOSE

CONCLUSIONS

- EAL, LAB FREQUENCY DATA MATCH WELL
- NEED TO GET MORE ACCURATE MEASUREMENTS FROM LAB, AND WITH MORE MODES FOR BETTER COMPARISON COMPUTER MODEL & LAB
- FOR HIGHER MODES, THE CANTILEVERED CONDITION MAY BE SUBSTITUTED FOR THE SUSPENDED, THUS REDUCING THE NUMBER OF NODES AND DOF'S IN COMPUTATION